Calothamnus sanguineus Labill. New Holland Honeyeaters probing, pollen on head, at Red Gum Springs.

Dryandra armata R.Br. (GK 2312) Probed by New Holland Honeyeaters, upper slopes Mt Success.

Dryandra cuneata R.Br. (GK 2333) Probed by a single New Holland Honeyeater, lower slopes Mt Success.

Grevillea aff *brownii* Meisn. (GK 2289) Western Spinebill, pollen on bill, Bluff Knoll.

Grevillea brownii Meisn. (GK 2337) Prostrate shrub, visited by single Singing Honeyeater, and a pair of New Hollands. Feed on ground 8 km East of the Porongurups.

Beaufortia anisandra Schau. (GK 2302) One New Holland probing, Mt Hassell.

Dryandra sessilis (Knight.) Domin (GK 2285) probed by pair of New Holland Honeyeaters, Red Gum Hill.

ANTS PROTECTING *BANKSIA* FLOWERS FROM DESTRUCTIVE INSECTS?

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ABSTRACT

A beneficial interaction between *Banksia media* and ants is suggested. Nectar produced from sites of insect damage on the immature conflorescence is thought to encourage ant patrolling of conflorescences and give protection against flower destroying insects.

INTRODUCTION

The confloreseence or flowering spike of *Banksia* is attacked by the larvae of Lepidoptera and Curculionidae. I have made observations on a

Fig. 1.—Immature *Banksia media* confloreseence with an unidentified ant species feeding on nectar produced at sites of insect damage.

number of species of *Banksia* and have found up to 90% of conflorescences attacked by insects (Scott, 1979). This causes a marked reduction in seed set. The usual mode of insect attack is for the adult insect to lay eggs on the conflorescence at the stage of development when the individual flowers are the same size as the bracts. The insect larvae eat through the bracts and developing flowers and by producing frass and stopping the development of flowers, make the point of attack obvious to the observer.

During April 13-16, 1979, I examined populations of *Banksia* in the Hopetoun and Ravensthorpe districts. *B. media, B. speciosa, B. violacea* were in flower and *B. baueri* and *B. quercifolia* var. *integrifolia* were beginning to flower.

OBSERVATIONS ON ANTS AND *BANKSIA MEDIA*

In the Fitzgerald River National Park near East Mount Barren ants were observed on the open flowers of *B. media* and *B. speciosa* but *B. media* differed because ants were also found on the undeveloped conflorescenees (Fig. 1). On closer examination some of these ants were feeding on liquid at points resembling sites of insect damage.

The liquid tasted sweet. From two plants I measured the equivalent of the percent sucrose of the liquid by using a Bellingham and Stanley Ltd. Refractometer. Values of 30 and 51 per cent sucrose were obtained. The high reading was taken in the afternoon and was probably affected by evaporation. The other reading was taken in the evening. Most of the damage sites did not have sufficient liquid to take a reading with the refractometer but numerous sites were seen to be visited by ants. The ants were also numerous on undamaged immature conflorescences. When the ants were disturbed on either the open flowers of immature conflorescences they became agitated but did not attack. The following ant species were involved: *Campanotus* species, *Crematogastar* species, *Dolichoderus* species, *Iridomyrmex conifer, I. purpureus* and two *Iridomyrmex* species and other species were noticed but not collected. The adult ants are nectarivores but feed their young with insect larvae (Peter McMillan pers. comm.). A number of bushes had only one ant species present but up to three were observed on a single conflorescence.

A similar situation to the above was observed at a spongilite quarry 17 km S.W. from Ravensthorpe on Scott Road and also about a kilometre east from the site of Kundip on the Hopetoun road. However at two other sites, 10 km from Ravensthorpe on the Hopetoun road and 41 km from Lake King on the Lake King to Ravensthorpe road, ants were only found on the open flowers and not on the immature conflorescences. The immature conflorescences at the latter two locations were also notable for the absence of insect attack or damage sites similar to the other populations.

FLOWER-DESTROYING INSECTS

Two species of insect appear to be destroying flowers at the Fitzgerald River National Park. Evidence of attack and destruction similar to that caused by the moth larvae of *Arotrophora arcuatalis* (Tortricidae) was observed. This moth is a major *Banksia* flower destroyer (Scott, 1979) and occurs in a number of *Banksia* species (Common, 1963; Scott, 1979). The other insect was the larvae of *Myositta* species (Curculionidae: Eugnominae). An adult *Myositta* sp. was observed preparing a site for egg laying on a mature flower spike. The female weevil eats a hole among the bracts and flowers and deposits eggs in the hole. Ants were also present and even walked over the weevil without disturbing it. This weevil is widespread as a flower destroyer among *Banksia* species (Scott, 1979).

EXPLANATIONS OF THE OBSERVATIONS

A number of suggestions arise from these observations. The most tempting is that at sites of insect attack, *B. media* produces nectar as a response to the wound. This nectar at the site of the wound acts as a reward to the ants, which patrol the immature conflorescence, tending the nectar

sources and possibly also collecting the eggs and larvae of the flower-destroying insects thus protecting the conflorescence from further damage. If this is the case then a large percentage of conflorescences would be expected to produce seed. When an insect larva burrows in the conflorescence it destroys some of the woody axis. Consequently no seed will be set above the lowest point of damage to the woody axis although there may be seed developed below. Therefore a measure of the absence of insect attack is the percentage of conflorescences which set seed at the top. This assumes adequate pollination. I examined fourteen large bushes in the Fitzgerald River National Park, selected in a semi-random fashion and examined a sample of infructescences (seed bearing cones) on each bush. Only infructescences which would have been produced in the previous three years were examined to avoid problems of decomposition of non-seeding conflorescences. Between 16 and 38 infructescences were inspected on each bush. For the sample of 14 bushes the average percent of infructescences without seed at the top was 12.4 with a standard error of the mean of 2.53. The non-seeding conflorescences were damaged by *A. arcuatalis* and *Myositta* sp. but each conflorescence may have had seed at the bottom. This is a very low percentage of confloreseences without seed at the top compared with other species (Scott, 1979). For comparison 58.6% of *B. ilicifolia*, 97.6% of *B. attenuata*, 78.5% of *B. grandis* and 95.0% of *B. menziesii*, at the Jandakot Marsupial Breeding Station, did not set seed on the top 20% of the conflorescence.

The other possibility is that ants damage the immature conflorescence to encourage nectar production. This is unlikely as some populations of *B. media* had ants on the flower but not on the immature confloreseence and ants could be found on conflorescences without any damage sites.

DISCUSSION

Associations between ants and nectar produced by plants are well known and reviewed in Bentley (1977) but have not been suggested for *Banksia*. Bentley was primarily concerned with extrafloral nectaries but it could be possible that a similar interaction between ants and nectaries of immature flowers occurs in *Banksia*. The points she lists which indicate a beneficial interaction are:—

1. Ants must be present on the plant.
2. Ants must show aggressive behaviour towards potential herbivores and/or be predators on the herbivores.
3. The plant must be vulnerable to herbivore attack.
4. To be most efficient, nectar flow should vary directly with the herbivores' activity.

The first point is true for *B. media*, however the second point is not shown by the observations. The ants are not aggressive to humans or to an adult weevil and it remains to be shown that ants remove insect larvae. *Banksia* species are thought to be primarily pollinated by birds (Paton and Ford, 1977; Whelan and Burbidge, 1979), so a lack of aggression by the ants could be beneficial from the plant's point of view. The plant is vulnerable to herbivore attack in the form of flower destroyers and nectar production appears to be initiated by the insect attack.

A simple experiment would test both if there is a beneficial relationship or if ants cause the damage. The ants could be excluded from the immature confloreseence and the resulting infructescence examined to see if there was a lower seed set than in conflorescences to which ants had access. If the sites of insect attack disappear when the ants are excluded then damage is caused by ants and not the flying adults of flower-destroying insects.

ACKNOWLEDGEMENTS

I would like to thank the staff and students of the Geology Department, University of Western Australia for organising the field trip to Hope-

toun. Peter McMillan of the Zoology Department, University of Western Australia, identified the ants. This work was financed by a University of Western Australia Postgraduate Studentship. I also thank B. Miller and W. R. Black for their comments.

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FROM FIELD AND STUDY

Insect Pollination of *Suaeda australis* (Chenopodiaceae).—*Suaeda australis* (R.Br.) Moq. is a common wind-pollinated perennial herb, found on damp saline soils throughout southern Western Australia. The author studied this species at Wilkie Street Swamp, South Guildford, where it formed a large monospecific stand on open saline black mud. Plants at this locality flower during summer producing copious amounts of pollen but no nectar. Observations during January and February 1978 showed large numbers of honey-bees (*Apis mellifera* L.) and syrphid flies were collecting pollen from open flowers. They visited from 1-20 flowers per plant before moving on. Flowers checked after visitations had pollen deposited on the stigma (plants from this area are self fertile). From the large number of visits and their systematic nature it is apparent that insect pollination must be of considerable importance in this population of normally wind pollinated herbs.

—G. J. KEIGHERY, Kings Park and Botanic Garden, West Perth.

Bird Records from the Salt Lake, Culeenup I. Yundurup.—The Salt Lake at the western end of Culeenup (Mill) Island, Yundurup had an unusually good assortment of birdlife when we visited it on May 12, 1979. There were literally dozens of White-faced Herons (we counted 36 in one flight) flying with some half-dozen White Egrets. Feeding among the samphire on the south side of the lake were several dozen Banded Stilts. Most exciting was the sighting of a White Ibis, flying with the egrets and herons. When we returned to the lake next day none of these birds were present.

The bird list for the Yundurup delta published in the *W.A. Naturalist*, 11 (7), 1970, p. 164, makes no mention of the White Ibis. However Naturalist Club records include a sighting of a flock of eight birds soaring in a thermal over Lot 24 on March 3, 1975.

—RAY OLDHAM, Swanbourne.

Pollination of *Nematolepis* (Rutaceae).—*Nematolepis* is an endemic genus of large shrubs which occurs on limestone clay soils between Lake Grace and Israelite Bay. The sole species *N. phebalioides* generally occurs in dense populations under mallee eucalypts within this region. Flowering occurs sporadically between April and December, but peak flowering is during spring (Aug.-Nov.). The flowers are solitary, tubular, coloured red